YALE JOURNAL OF BIOLOGY AND MEDICINE 74 (2001), pp. 179-184.

CLASSICS OF BIOLOGY AND MEDICINE

Peculiar Elongated and Sickle-shaped Red Blood Corpuscles in a Case of Severe Anemia[a]

James B. Herrick, M.D.

1013 State Street, Chicago, Illinois

This case is reported because of the unusual blood findings, no duplicate of which I have ever seen described. Whether the blood picture represents merely a freakish poikilocytosis or is dependent on some peculiar physical or chemical condition of the blood, or is characteristic of some particular disease, I cannot at present answer. I report some details that may seem non-essential, thinking that if a similar blood condition is found in some other case a comparison of clinical conditions may help in solving the problem.

HISTORY

The patient was an intelligent negro of 20, who had been in the United States three months, during which time he was a student in one of the professional schools in Chicago. His former residence had been Grenada, West Indies, where he had been born and brought up, one of a family of four children, all living, and all well with the exception of himself. His mother was living and in good health; his father had died of accident. At the age of 10 the patient had had yaws. This was a common disease in the locality where he lived. The lesions, as he described them, had been pustular, with formation of ulcers and scabs. On healing, scars, many of which he pointed out, were left. Some of the ulcers had been as large as a silver quarter of a dollar. The disease lasted about one year and during this time he had felt somewhat weak and indisposed. Most of the ulcers had been on the legs and the patient him-

[a] Editor's Note: From time to time the Journal will re-publish classic papers of biology and medicine from sources that may be hard to find or unavailable in many libraries. This 1910 article by the Chicago physician, Dr. James B. Herrick, describes the first recognition of sickle cell anemia. Herrick's clinical description is clear and his intuition as to the underlying cause of the abnormal sickle cells is striking to the modern reader. Historical analysis of this work is found in recent publications of Todd Savitt: "The invisible malady: sickle cell anemia in America, 1910-1970." J. Natl. Med. Assoc. 73:739-46, 1981; (with M.F. Goldberg) "Herrick's 1910 case report of sickle cell anemia: the rest of the story." JAMA 261:266-271, 1989; and "The second reported case of sickle cell anemia. Charlottesville, Virginia, 1911." Va. Med. Q. 124:84-92, 1997. Subsequent pathophysiological classics on sickle cell hemoglobin include: Linus Pauling, Harvey Itano, S. Jon Singer, and I.C. Wells, "Sickle-cell anemia: a molecular disease." Science 110:543-548, 1949; and Vernon Ingraham, "Gene mutation in human hemoglobin: the chemical difference between normal and sickle-cell hemoglobin." Nature 180:326-328, 1957.

self had thought that this location of the lesions might have been due to the bruises and scratches that were frequently produced as he ran about, a barefoot boy, through the streets and the brush. He was sure he had never had ground-itch, though he said it was not uncommon in Grenada. He had attended school up to the age of 17. Since leaving school, that is, for the past three years, he had felt a disinclination to take exercise. For about a year he had noticed some palpitation and shortness of breath which he had attributed to excessive smoking. There had been times when he thought he was bilious and when the whites of the eyes had been tinged with yellow. At such times he had not had any pain, chill or fever. Three years previously he had had a purulent discharge from the right ear lasting six months. He had had no diarrhea and no hemorrhages at any time. He denied syphilis and gonorrhea. There was never any rheumatism or other joint trouble. On landing in New York in September, 1904, he had a sore on one ankle for which he consulted a physician. Tincture of iodin was applied and in a week, the sore healed, leaving a scar similar to the others on the limbs. For the past five weeks he had been coughing. Two days prior to examination he had "taken cold," his cough had grown worse and he had had a slight chill, followed by fever. It was this cough and fever for which he wished treatment at the hospital, and of which he chiefly complained, though he mentioned also that he felt weak and dizzy, had headache and catarrh of the nose.

PHYSICAL EXAMINATION

This showed him to be a young man of typical negro facies, with black, curly hair. He was fairly well developed physically and was bright and intelligent. There was a tinge of yellow in the sclera and the visible mucous membranes were pale. The eyes were normal; the pupils showed prompt reaction to light and in accommodation. The hearing was good; there was no discharge from the ear. The nose showed chronic and acute rhinitis. The tongue was coated, the pharynx slightly reddened; no scars or other lesions were found here. The cervical glands were definitely enlarged, hard and not painful. The axillary, inguinal and epitrochlear glands were also enlarged, some in the axilla being of the size of almonds. Over the chest and abdomen were several good-sized leukodermatous patches, the intervening skin being rather deeply pigmented. The scars to which be had referred were nearly all located on the legs and thighs, some in the former location being as much as 3 cm. in diameter. There were perhaps twenty scars in all. They were rounded or oval, sometimes of irregular contour, the edges clean-cut; some were like tissue paper or thin parchment to the touch and were lighter in color than the surrounding skin. They were strikingly like scars often seen as the result of syphilis. The chest was well formed. There was fair expansion. Numerous râles, mostly of the moist variety, were heard scattered throughout the chest, especially posteriorly. There was a slight relative dulness over the base of either lung behind. The heart was enlarged to the left, the apex impulse being in the sixth interspace one inch to the left of the left mammillary line. There was but a slight increase in the dullness to the right. A soft systolic murmur, not well transmitted in any direction, was heard over the base of the heart. A faint systolic murmur, or perhaps it would be better to call it an impure first tone — was heard at the apex. The heart's action reminded one of a heart under strong stimulation, though no history of ingestion of a stimulant of any kind was obtainable. Basedow's findings were not to be made out. The pulse was of good quality and of fair volume. The abdomen

was not distended nor was it tender. Neither spleen nor liver could be palpated. There was no tenderness over the gall-bladder region. The genitalia were normal. The patellar reflexes were sluggish. There was no ataxia and there were no sensory disturbances.

The temperature on admission was 101°F. It varied between 99° and 101° for four days, then gradually subsided, though for the next three weeks it was often found between 99 and 100 F., though with no regularity. The pulse varied from 64 to 104. averaging about 80. There was never any rapid breathing.

URINE AND SPUTUM

The urine was amber in color, specific gravity 1.010 to 1.014, slightly increased in amount – 2,000 c.c. – acid, contained a distinct trace of serum-albumin, a few granular and hyaline casts. This represents the average of several examinations. The urine on admission had a trace of bile. December 28, urinary examinations for hemoglobin and hematoporphyrin were made and none found. Tests were made for paramidophenol, but none was found.

No tubercle bacilli were discovered in the sputum.

BLOOD EXAMINATION

The blood-count on Dec. 26, 1904, was: Red corpuscles, 2,570,000; white corpuscles, 40,000; hemoglobin (Dare) 40 per cent. color index, 0.78. December 31 the count was as follows:

Erythrocytes, 2,880,000.

Leukocytes, 15,250.

Hemoglobin, 50 per cent. (Dare).

The red corpuscles varied much in size, many microcytes being seen and some macrocytes. Polychromatophilia. was present. Nucleated reds were numerous, 74 being seen in a count of 200 leukocytes, there being about 5,000 to the c.mm. The shape of the reds was very irregular, but what especially attracted attention was the large number of thin, elongated, sickle-shaped and crescent-shaped forms. These were seen in fresh specimens, no matter in what way the blood was spread on the slide and they were seen also in specimens fixed by heat, by alcohol and ether, and stained with the Ehrlich triacid stain as well as with control stains. They were not seen in specimens of blood taken at the same time from other individuals and prepared under exactly similar conditions. They were surely not artefacts, nor were they any form of parasite. In staining reactions they were exactly like their neighbors, the ordinary red corpuscles, though many took the stain heavily. In a few of the elongated forms a nucleus was seen. In the fresh specimen where there was a slight current in the blood before it had become entirely quiet, all of the red corpuscles, the elongated forms as well as those of ordinary form, seemed to be unusually pliable and flexible, bending and twisting in a remarkable manner as they bumped against each other or crowded through a narrow space and seeming almost rubber-like in their elastic resumption of the former shape. One received the impression that the flattened red discs might by reason of unusual pliability be rolled up as it were into a long narrow bundle. Once or twice I saw a corpuscle of ordinary form turn in such a way as to be seen on edge, when its appearance was suggestive of these peculiar forms.

The white corpuscles were made up of polymorphonuclear neutrophils 72 per cent., small mononuclear lymphocytes 15 per cent., large mononuclear forms 7 per cent., polymorphonuclear eosinophils 5 per cent., myelocytes (?) 1 per cent. Many polymorphonuclear cells and some mononuclear forms contained basophilic granules (Neusser's perinuclear basophils [?]). In overheated specimens especially, a

number of cells with shadowy outlines and staining but slightly were seen. These resembled white cells.

STOOLS

The stools were examined not only as a matter of routine, but because of the possibility of detecting the presence of some parasite that might explain the eosinophilia, leukocytosis and anemia, a possibility not at all unlikely in one coming from the tropics and who had lived where ground-itch was a common occurrence. Many stools were thoroughly studied. Considerable mucus was found in some of the stools passed soon after admission, and some of the mucus was blood-stained. No blood was found in the interior of the fecal masses. On two occasions preceding the giving of the thymol, a body was found resembling almost typically the egg of *Ankylostoma duodenale*. Portions of the stools were incubated, but no embryos were to be made out. Thymol was given, but neither eggs nor embryos could be found in the stools, following its administration.

TREATMENT AND COURSE OF DISEASE

Under treatment, consisting of rest, nourishing food and syrup of the iodid of iron, the fever and râles disappeared, the glands became smaller, the blood improved in quality and the patient left the hospital after a four-weeks' stay, declaring that he felt well. The possible therapeutic influence of the thymol must also not be overlooked. The blood at this time showed 3,900,000 red corpuscles, 15,000 white, 58 per cent. hemoglobin. There was still to be seen a tendency to the peculiar crescent-shape in the red corpuscles though this was by no means so noticeable as before. Nucleated reds were present, though in smaller numbers. Eosinophils were found as before, making up about 5 pet cent. of the total number of leukocytes.

We were at a loss to account for this peculiar complexus of symptoms, a condition evidently chronic as revealed by the history of the past three years, with yaws and suppurating otitis as predecessors, yet with acute exacerbations, a condition not clearly explained on the basis of an organic lesion in any one organ, yet showing cardiac enlargement, albuminuria and cylindruria, general adenopathy, icterus, with a secondary anemia not remarkable for the great reduction in red corpuscles or hemoglobin, but strikingly atypical in the large number of nucleated red corpuscles of the normoblastic type and in the tendency of the erythrocytes to assume a slender sickle-like shape. The leukocytosis with a rather high eosinophil count was also to be noted.

An attempt was made to keep track of the patient, and while he was never afterward under my professional care he was twice seen by myself and several times by Dr. E.E. Irons, whose notes and blood-examinations are here given:

> January, 1906: Patient in a hospital for a few days with bronchitis. Rapid recovery.
>
> March 7, 1906: Patient in bed with fever, bronchitis; feels weak, No diarrhea. Red blood corpuscles 2,700,000, whites 30,500; hemoglobin 55 per cent. Blood shows many elongated erythrocytes, a few microcytes. The elongated and spindle-forms seemed to stain more darkly than the normal round red corpuscles. No parasites were seen. The differential count of the white cells showed polynuclea r neutrophils 58, large mononuclear 12, small mononuclear 22, eosinophils 7, myelocytes 1. There were 2,279 normoblasts to the cubic millimeter.
>
> A count on March 14, 1906, showed an increase in the reds, a lessening of the whites, but was in other respects practically the same. The stool was normal in appearance, formed, yellowish brown, and no blood or eggs were found. The urine was acid, clean, with no blood or abnormal pigment. There was a trace

of albumin, and several granular and hyaline casts were found.

In May, 1906, the patient was seen by Dr. Irons, who found him with some fluid in the left knee-joint; the temperature was 100. Gonorrhea was denied. The patient ascribed the joint trouble to a wrench of the knee a few days before. He recovered after ten days of rest in bed.

In April, 1907, the young man reported that be had been laid up in a hospital from Dec. 26, 1906, to Feb. 26, 1907, with what he called muscular rheumatism. His illness had begun with malaise, pain in the back, the muscles of the legs and arms. He had had a slight fever and was pale. A few days before this illness he had suffered from one of his "bilious" attacks, in which he had had quite severe epigastric pain, had vomited and had later noticed that the urine was dark and that the sclerae were yellowish, though he was inclined to think the icteric hue had been present before the onset of the pain. He was still, he said, somewhat short of breath, but in other respects felt quite well. Since then I have never seen or heard from him.

COMMENT

No conclusions can be drawn from this case. Not even a definite diagnosis can be made. Syphilis is suggested by many of the facts, such as adenopathy and the condition of the heart and kidneys; it might explain the anemia, the arthritis and perhaps also the temperature, cough and attacks of pain resembling hepatic or gallbladder disease, for as is well known, visceral syphilis may furnish a most bizarre group of symptoms. The Wassermann test was not in use at this time. The scars said

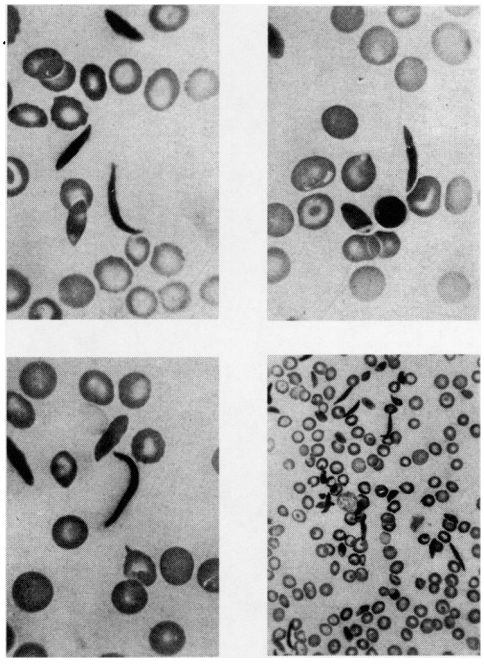

Figure 1. These photomicrographs show the peculiar elongated forms of the red corpuscles. Occasional shadow forms are seen with a few nucleated reds. The variations in shape and size are best made out in the low-power figure. The relatively number of white corpuscles and of normoblasts is not shown by these particular figures.

to have been due to yaws were like those left by syphilis.

The patient coming from the tropics, one thought of intestinal parasites such as uncinaria as a possible explanation of the anemia and the eosinophilia. What were thought to be eggs were found on one occasion only, and after thymol there was temporary improvement.

The odd blood picture made one examine for possible toxic effects of the coal-tar preparations, but neither from the history nor from the examination of the urine was there any evidence that such drugs were habitually taken. We were at this time particularly interested in the subject of chronic acetanilid intoxication as well as in uncinariasis, having just had a case of each of these interesting conditions under observation, so that we were on the lookout for such out-of-the-way diseases.

The question of diagnosis must remain an open one unless reports of other similar cases with the same peculiar blood-picture shall clear up this feature.

Schleip, in his "Atlas," pictures fresh unstained preparations of red blood-corpuscles made by his method of diluting the blood 1 to 10 with physiologic salt solution and examining with the aid of the hanging drop chamber. Some of the corpuscles remind one a little of these forms I have described. Yet they are not exactly the same.

Professor Hektoen showed me a specimen that he had encountered in the course of some of his hematologic work, which most nearly resembles these forms. This preparation was one in which washed human corpuscles were suspended in a one-eighth-normal solution of cane-sugar. But neither Dr. Hektoen nor I have been able to reproduce the exact picture again, though using cane sugar solution of the same strength. This, while suggesting that the chemical composition of the fluid suspending the corpuscles may have something to do with these peculiar formations, perhaps suggests more strongly that some unrecognized change in the composition of the corpuscle itself may be the determining factor.

Reprinted from: Arch. Int. Med. 5:517, 1910.